3. Subbasin Assessment – Pollutant Source Inventory

3.1 Point Sources

There are no point source discharges in the Upper Owyhee Watershed.

3.2 Nonpoint Sources

Temperature

There are many natural factors that can affect water temperature. These natural factors are known as drivers, which may include topographic shading, upland vegetation, precipitation, air temperature, wind speed, solar angle cloud cover, relative humidity, phreatic ground water temperature and discharge, and tributary temperature and flow (Poole and Berman 2000). It is when the influence of anthropogenic sources alters the ecological drivers and other physical characteristic that an out-of-balance heat exchange can occur.

Some of the physical factors affecting the drivers in the Upper Owyhee Watershed may include removal of adequate stream cover (riparian vegetation), upland vegetation changes (ground water infiltration) and stream morphology degradation (increased width-depth ratio, floodplain access). Along with physical factors, there are climatic factors that should be considered, such as snowmelt, ambient air temperature and precipitation. During 2000 and 2001 precipitation for the Upper Owyhee Watershed was below normal, both in yearly snowpack and summertime precipitation. These climatic conditions can alter the amount of flow, which will affect water temperature (Poole and Berman 2000).

High water temperatures in the Upper Owyhee Watershed appear to be associated with solar radiation, ambient air temperature and lack of ground water influence. All can have a direct or indirect effect on water temperature and can be influenced by a variety of physical attributes and stream-riparian conditions.

Solar radiation is the direct impact of solar energy on water. Different conditions can alter the amount of solar radiation reaching the water surface or the amount of water surface available to solar radiation. Reducing shading or stream cover has been shown to increase the water temperature (Teti 1998). Brown (1970) showed solar radiation on water surfaces was the greatest factor in high water temperature during critical summertime periods. The other physical characteristic affecting solar radiation is the amount of surface area exposed. A wide shallow stream allows for more surface area to be affected by solar radiation (width-depth ratio).

Lack of adequate stream (canopy) cover can affect the heat transfer from water to air. Stream cover provides a buffering capability for the interaction between water surface and the ambient air by reducing wind speed over water surface. It can also affect the relative humidity near the water surface, which affects the degree of heat transfer. Water evaporation rates increase when there is greater wind speed and solar radiation. This condition will reduce the amount of available water within the stream channel.

Ground water influences have been altered in many of the C channel type streams in the Upper Owyhee Watershed. These stream types are usually associated with low gradient (<2%) wet meadow type hydrologic conditions. As many of these systems down-cut into finer course material, ground water levels in the adjacent areas lower dramatically. In some areas these down-cuts have deepened the stream channel 3-6 meters below what was once the historic stream elevation. Old stream channels are evident in many of the low gradient stream areas. With the downcutting into these systems, there is a loss of the ability of the stream to have access to the historic floodplain and the ground water storage these systems are capable of achieving (Thomas et al. 1998). As these areas down-cut, ground water also retreated to a base flow and was greatly reduced once the stream hit a less erodible material, such as bedrock or hardpan. With this natural geological material, ground water storage is inadequate to provide crucial recharge during summertime flows, altering both the flow and water temperature.

Another factor to be considered is the effect on the hyporheic flow condition (below streambed flow). The hyporheic flow relies on the ability of streams to form pools and riffles, and the near benthic area of the stream to cool water for surface water. As water enters a pool or a meander, there is a natural driver for surface water to be forced into the ground. Ground water will follow gravity and flow downstream and reenter the stream at a lower or equal elevation from which it entered. As the ground water passes through alluvial soils, it is cooled to the ambient soil temperature (Wroblicky et al. 1996; Stanford, Ward and Ellis 1994).

As many of the streams in the Upper Owyhee Watershed down-cut, the natural capability to form meanders and adequate riffle-pool ratio diminishes. This indicates these streams have also lost the natural hyporheic flow driver for water temperature buffering. Stream sinuosity and the presence of geomorphic features are other factors in stream and hyporheic flow conditions. The lack of an adequate floodplain, side channels and backwaters are critical influences for hyporheic flows and water temperature (Poole and Berman 2000).

As described by Dupont (1999*a*), the current down-cutting of the streams in the North and Middle Fork Owyhee Watersheds is probably not entirely associated with current land use practices, but with the removal of beavers from the area (Idaho DEQ 1999*c*). The removal of beavers and the lack of maintenance of their dams allowed streams to down-cut into the course material that were, at one time, held back by beaver activity. This is also true for those streams in the Upper Owyhee Watershed.

This downcutting occurred until the stream met a more stable substrate (i.e., bedrock, hardpan), then stabilized. Under natural conditions, the stream will slowly regain access to the historic floodplain, building back up through the deposition of fine material during high flows. The presence of adequate vegetation is critical during this process for reducing stream velocity and providing streambank protection (Thomas et al. 1998).

Sediment

Sediment sources in the Upper Owyhee Watershed can vary from streambank erosion, overland flow, wind blown deposition, and instream channel transport. There is little information on any sources that can provide a quantitative estimate of the delivery rate to streams showing sediment is impairing the existing uses. However, studies have shown a direct impairment of aquatic biota communities and sediment from associated land use practices (Strand and Merritt 1999).

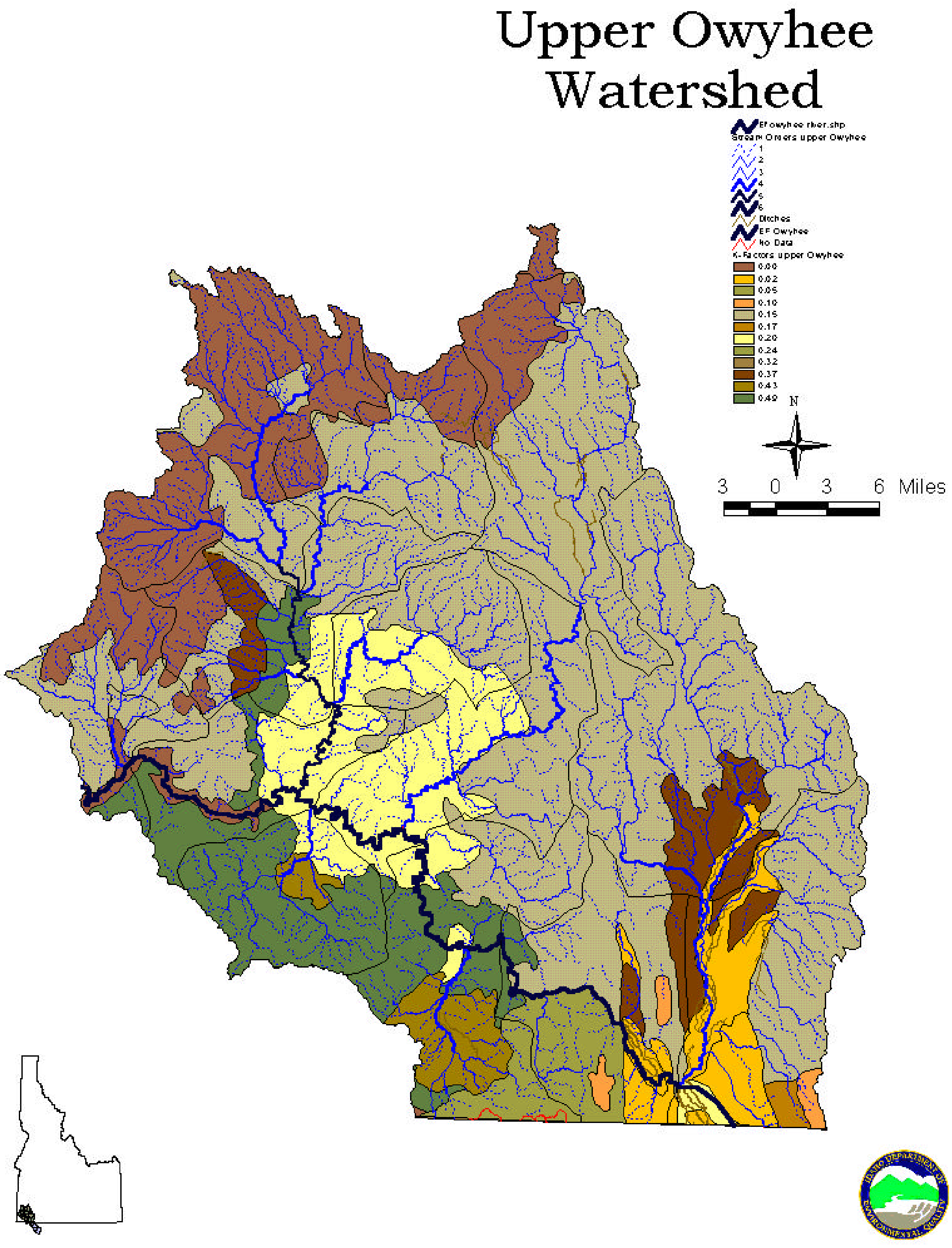
Overland flow usually consists of gully erosion, mass wasting and general surface erosion. Since there is a certain amount of overland flow sediment that gets tied up in hillside storage, it is very difficult to determine the exact delivery rate to water bodies from this source. The Natural Resources Conservation Service (NRCS) has determined the erosion factors for many areas in Owyhee County, including the Upper Owyhee Watershed. One factor in determining erosion is the K-Factor, or the measure of soil erodibility as affected by intrinsic soil properties (National Sedimentation Laboratory 2002). Along with other factors such as slope, slope length, cover and erosivity of the climate, a determination of average annual soil loss can be determined based on tons/acre/year.

Low K values, (0.05-0.15) where soils are mostly high in clay content and are more resistant to detachment, are typically the least erodible. Silt-loam soils are more easily detached and have a K value of greater than 0.4. Table 26 shows the percent and total number of acres that demonstrate certain K values in the Upper Owyhee Watershed. Figure 11 shows a schematic of K-Values in the watershed.

Table 26. K Values and Acreage Percent. Upper Owyhee Watershed.

K-Value Factor*	Erodibility	Acres*	Percent*
0.0	Low	157,628	14.8%
0.02	Low	43,143	4.1%
0.05	Low	32,971	3.1%
0.1	Low	7,100	0.7%
0.15	Low	498,904	46.9%
0.17	Medium	3,081	0.3%
0.2	Medium	105,051	9.9%
0.24	Medium	4,642	0.4%
0.32	Medium	20,742	1.9%
0.37	Medium	42,598	4.0%
0.42	High	49,645	4.7%
0.49	High	99,222	9.3%
Total		1,064,727	100%

aData obtained from USDepartment of Agriculture –Natural Resource Conservation Service STATSGO database. Some acreage are within Nevada and not delinated.



Data obtained from USDA-NRCS STATSGO database.

Figure 11. Erosion K-Factors. Upper Owyhee Watershed.

Slope of the land and other variables such as precipitation, wind erosion, the erosion potential of soils and other natural factors can also affect overland erosion. In the case of the Upper Owyhee Watershed, slope does not appear to be a critical factor in overland erosion. Table 27 shows percent slopes acreage within the Upper Owyhee Watershed along with the percentage the slope covers in the watershed. The percent slope was obtained from the weighted average per the map unit ID obtained from state soil geographic database (STATSGO). The table represents an overall average for the area.

Table 27. Slope, Acreage[a] and Percent. Upper Owyhee Watershed.

Slope (%)	<5%	> 5% and <10%	>10% and <15%	>15% and <20%	> 20% and <25%	>25%	Total
Acreage	49,747	198,815	8,995	736,655	5,909	11,982	1,012,103
% of Total	4.9%	18.6%	0.9%	72.8%	0.6%	11.8%	109.60%

aTotal acres from K Factor values differ due to calculation factors of GIS-STATGO layers.

The Owyhee Resource Management Plan (ORMP) (BLM 1999) identified those areas with a slope exceeding 30%, a K-Factor value of greater than 0.43 and wind erodible group (WEG) value of less than 4 as critical areas for high soil erosion. Less than 1% of the land in the Upper Owyhee Watershed had a WEG of less than 4. The ORMP does not provide much detail on the overall critical areas for high soil erosion areas within the Upper Owyhee Watershed, but does identify areas within some land use areas where current practices have high soil erosion potential within in the BLM management area. Since the Upper Owyhee Watershed takes in a small percentage of the area addressed in the ORMP (east of Deep Creek) the critical soil erosion areas appear, but are much less frequent in the remainder of the Upper Owyhee Watershed.

Smaller subwatersheds (1st and 2nd order streams) provide some sediment load to the larger streams that are listed for sediment as a pollutant of concern. However, since many of these smaller watersheds only provide sediment input during snowmelt and storm events, it is very difficult to determine actual sediment loads from these subwatersheds.

Review of aerial or LANSTATS photos do not indicate that mass wasting or roads are critical factors or sources of sediment in the Upper Owyhee Watershed. The road density in the watershed is so low that the use of current Geographical Information System (GIS) databases cannot determine density.

Although not easily quantified, streambank erosion can be significant source of sediment. As seen in Figures 12 and 13, sediment from streambank erosion provides a continuous source of sediment.

Figure 12. Deep Creek near Mud Flat Road. Upper Owyhee Watershed.

Figure 13. Deep Creek near Castle Creek Confluence. Upper Owyhee Watershed.

Stream geomorphology changes associated with beaver removal started in the late 1700s and early 1800s. The removal of the beaver population probably continued until the area was depleted or was no longer profitable. Even in the early 1900s the state of Idaho noted the depleted beaver population and prohibited the taking of beavers until 1957 (Platts and Onishuk 1988). In the early 1860s, a more extensive and permanent presence of man is documented, along with the current land use practices. As described earlier, the riparian areas were the most productive lands and were used for farming and ranching (Adams 1986).

The use of the vegetation along riparian corridors can be directly related to streambank erosion (Mosely et al. 1997, Platts and Nelson 1985, Platts 1979). This is especially evident in old C channel (Figure 14) types or in wet meadows where downcutting has occurred and access to the historic floodplain has been lost. Figure 15 shows the development of a "nick point" upstream of a down-cut area on Castle Creek.

Measurement of streambank erosion is easily quantifiable with direct evaluation of critical areas. Goals and objectives can be set that reflect conditions for reduction of sediment loads on those streams showing impairment from sediment.

Figure 14. Pole Creek near Mud Flat Road. Upper Owyhee Watershed.

In-channel storage and transport of sediment is a naturally occurring process. It is when the sediment load is out of balance with the natural sediment load balance, that impairment happens to the natural hydrology functions. It should be noted that the Upper Owyhee Watershed is a semi-arid climate and heavy, but brief precipitation events take place. However, with the removal of vegetation along stream riparian areas, these events have a detrimental effect and can exacerbate streambank erosion.

In-stream sediment can be measured a variety of ways: percent fines, pool volume, thalweg profile and cobble embeddeness.

Figure 15. Nick-point on Castle Creek. Upper Owyhee Watershed.

4. Subbasin Assessment – Summary of Past, Present and Implementation Strategy for Pollution Control Efforts

4.1 Point Sources

There are no point sources in the Upper Owyhee Watershed.

4.2 Nonpoint Sources

The state has responsibility under Sections 401, 402 and 404 of the CWA to provide water quality certification. Under this authority, the state reviews dredge and fill, stream channel alteration and National Pollutant Discharge Elimination System (NPDES) permits to ensure the proposed actions will meet the state of Idaho WQS.

Under Section 319 of the CWA, each state is required to develop and submit a nonpoint source management plan (NSMP). Idaho's NSMP has been submitted to the EPA and has been approved (Idaho DEQ 1999*b*). The NSMP identifies programs for implementation of BMPs, identifies available funding sources and includes a schedule for program milestones. It is certified by the state of Idaho Attorney General to ensure adequate authorities exist to implement the NSMP.

Idaho's NSMP describes many of the voluntary and regulatory approaches the state will take to abate nonpoint source pollution. Section 39-3601, et seq., includes provisions for public involvement, such as the formation of Basin Advisory Groups (BAG) and Watershed Advisory Groups (WAG) (IDAPA§ 58.01.02.052). The WAGs are established in high priority watersheds to assist Idaho DEQ and other state agencies in formulating specific actions needed to control point and nonpoint sources of pollution affecting water quality limited segments. A WAG was formed to assist with the *North and Middle Fork Owyhee Subbasin Assessment and Total Maximum Daily Load* (Idaho DEQ 1999*c*) and implementation plan. It is proposed this WAG be used as the main stakeholder contact for the Upper Owyhee Watershed TMDL and its implementation plan. This implementation plan must be completed within 18 months after approval of the TMDL.

The state of Idaho uses a voluntary approach to control agricultural nonpoint sources. However, regulatory authority can be found in the WQS (IDAPA§ 58.01.02.350.01 through 58.01.02.350.03). IDAPA§ 58.01.02.054.07 refers to the Idaho Agricultural Pollution Abatement Plan (Ag Plan) which provides direction to the agricultural community-approved BMPs (IDA-SCC 1993). A portion of the Ag Plan outlines responsible agencies or elected groups (Soil Conservation Districts [SCDs]) who will take the lead if nonpoint source pollution problems need to be addressed. For agriculture, it assigns the local SCDs to assist the land owner/operator with developing and implementing BMPs to abate nonpoint source pollution associated with the land use. If a voluntary approach does not succeed in abating the pollutant problem, the state may seek injunctive relief for those situations that may be determined to be an imminent and substantial danger to public health or environment (IDAPA§ 58.01.02.350.02(a)).

The Idaho WQS specify if water quality monitoring indicates WQS are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request the designated agency evaluate and/or modify the BMPs to protect beneficial uses. If necessary, the state may seek injunctive or other judicial relief against the operator of a nonpoint source activity in accordance with the Idaho DEQ Director (Section 39-108, Idaho Code) and (IDAPA§ 58.01.02.350).

The WQS list designated agencies responsible for reviewing and revising nonpoint source BMPs. Designated agencies are Department of Lands for timber harvest activities, oil and gas exploration and development and mining activities; the Soil Conservation Commission (SCC) for grazing and agricultural activities; the Department of Transportation for public road construction; the Department of Agriculture (IDA) for aquaculture; and Idaho DEQ for all other activities (IDAPA§ 58.01.02.003). The Idaho WQS refer to existing authorities to control nonpoint source pollution sources in Idaho. Some of these authorities and responsible agencies are listed in Table 28.

Table 28. Regulatory Authority for Nonpoint Pollution Sources. Upper Owyhee Watershed.

Nonpoint Source BMPs	Primary Responsible Agency or Agencies	Code/Regulation or Authority Involved
Idaho Forest Practice Rules	Idaho Department of Lands, Board of Land Commissioners	Idaho Code §39-3602, IDAPA§ 58.01.02.003.62, IDAPA§ 58.01.02.350.03
Rules Governing Solid Waste Management	Idaho Department of Environmental Quality and the Health Districts	IDAPA§ 58.01.02.350.03(b)
Rules Governing Subsurface and Individual Sewage Disposal Systems	Idaho Department of Environmental Quality and the Health Districts	Idaho Code §39-3602, IDAPA§ 58.01.02.350.03(c), IDAPA§ 58.01.15
Rules and Standards for Stream-channel Alteration	Board of Water Resources	IDAPA§ 58.01.02.350.03(d)
Rules Governing Exploration and Surface Mining Operations in Idaho	Idaho Department of Lands, Board of Land Commissioners	Idaho Code §39-3602, IDAPA§ 58.01.02.350.03(e), IDAPA§ 58.01.02.003.62
Rules Governing Placer and Dredge Mining in Idaho	Idaho Department of Lands, Board of Land Commissioners	IDAPA§ 58.01.02.350.03(f)
Rules Governing Dairy Waste	Idaho Department of Agriculture	IDAPA§ 58.01.02.350.03.(g) or IDAPA§ 58.01.02.04.14

The BIA and the Shoshone-Paiute Tribes are responsible for administering, managing and protecting approximately 12.1% (122,375 acres) of all lands within the Upper Owyhee Watershed (Duck Valley Indian Reservation, Idaho). Tribal WQS and/or the EPA determine if any water quality limited segments are present within tribal boundaries. Any control actions will also be the responsibility of the BIA/ Shoshone-Paiute Tribes and/or the EPA.

The BLM is responsible for administering, managing and protecting approximately 73.8% (746,833 acres) of the land in the Upper Owyhee Watershed. The agency has authority to regulate, license and enforce land use activities that affect nonpoint source pollution control from the Taylor Grazing Act, the federal CWA, the Federal Land and Policy Management Act, the Public Rangelands Improvement Act, the National Environmental Policy Act, the Emergency Wetlands Resource Act, the Agricultural Credit Act, the Land and Water Conservation Act and the Executive Orders for Floodplain Management and Protection of Wetlands.

The BLM is active in several interagency efforts to integrate priorities and provide implementation opportunities and tools for nonpoint source activities, such as the State Technical Committee, State BMP Committee, Coordinated Resource Management Plan (CRMP) Committee, and Agricultural TMDL Action Committee. The BLM participates in several §319 grants statewide for prevention and control of nonpoint source pollution.

Past management activities by the BLM in this subbasin include some livestock exclusion from riparian areas, pasture management with planned grazing systems, reservoir development, spring or water development in uplands and streambank protection. The *Owyhee Resource Management Plan and Final Environmental Impact Statement* (ORMP) includes pollution control activities that will be implemented over the next several years (BLM 1999). This document only affects the portion of the watershed from Deep Creek west to the Oregon state line. The selected alternative includes grazing management, which is meant to attain proper functioning and satisfactory riparian conditions and meet or exceed Idaho WQS in streams within the described portions of the Upper Owyhee Watershed. Examples of potential management activities are proper timing of grazing to minimize soil erosion, grazing management that provides adequate residual stubble height and proposed funding for range development projects to support management adjustments over a 20- year period.

4.3 Implementation Strategies

Overview

The purpose of this implementation strategy is to outline the pathway by which a larger, more comprehensive, implementation plan will be developed 18 months after TMDL approval. The comprehensive implementation plan will provide details of the actions needed to achieve load reductions (set forth in a TMDL), a schedule of those actions, and specify monitoring needed to document actions and progress toward meeting state water quality standards. These details are typically set forth in the plan that follows approval of the TMDL. In the meantime, a cursory implementation strategy is developed to identify the general issues such as responsible parties, a time line, and a monitoring strategy for determining progress toward meeting the TMDL goals outlined in this document.

The geographic scope of this TMDL effort encompasses the entire Upper Owyhee Watershed 4th Field HUC, 17050104. The water bodies to be addressed include Castle Creek, Red Canyon Creek, Deep Creek, Nickel Creek, Pole Creek, Juniper Basin Reservoir, and Blue Creek Reservoir. These water bodies and the pollutants to be addressed in the Implementation Plan are located in Table 22. Section 1.1 describes the water bodies and the listed segments.

Responsible Parties

Development of the final implementation plan for the Upper Owyhee Watershed TMDL will proceed under the existing practice established for the state of Idaho. The plan will be cooperatively developed by Idaho DEQ, the Owyhee WAG, and other "designated agencies" with input from the established public process. Of the three entities, the WAG will act as the integral part of the implementation planning process to identify appropriate implementation measures. Other individuals may also be identified to assist in the development of the site-specific implementation plans as their areas of expertise are identified as beneficial to the process. Together, these entities will recommend specific control actions and will then, with the BAG, review the specific implementation plan before submitting it to Idaho DEQ. Idaho DEQ will act as a repository for approved implementation plans.

Designated state agencies are responsible for assisting with preparation of specific implementation plans, particularly for those sources for which they have regulatory authority or programmatic responsibilities. Idaho's designated state management agencies are located on Table 26.

To the maximum extent possible, the implementation plan will be developed with the participation of federal partners and land management agencies (i.e., NRCS, U.S. Forest Service, BLM, Bureau of Reclamation, etc.). In Idaho, these agencies, and their federal and state partners, are charged by the CWA to lend available technical assistance and other appropriate support to local efforts/projects for water quality improvements.

All stakeholders in the Upper Owyhee Watershed subbasin have a responsibility for implementing the TMDL. Idaho DEQ and the "designated agencies" in Idaho have primary responsibility for overseeing implementation in cooperation with landowners and managers. Their general responsibilities are outlined below.

- **Idaho DEQ** will oversee and track overall progress on the specific implementation plan and monitor the watershed response. Idaho DEQ will also work with local governments on urban/suburban issues.
- **IDL** will maintain and update approved BMPs for forest practices and mining. IDL is responsible for ensuring use of appropriate BMPs on state and private lands.
- **ISCC**, working in cooperation with local Soil and Water Conservation Districts and ISDA, the NRCS will provide technical assistance to agricultural landowners. These agencies will help landowners design BMP systems appropriate for their property, and identify and seek appropriate cost-share funds. They also will provide periodic project reviews to ensure BMPs are working effectively.

The designated agencies, WAG, and other appropriate public process participants are expected to:

- Develop BMPs to achieve LAs
- Give reasonable assurance that management measures will meet LAs through both quantitative and qualitative analysis of management measures
- Adhere to measurable milestones for progress
- Develop a timeline for implementation, with reference to costs and funding
- Develop a monitoring plan to determine if BMPs are being implemented, individual BMPs are effective, LA and WLA are being met, and water quality standards are being met

In addition to the designated agencies, the public, through the WAG and other equivalent processes, will be provided with opportunities to be involved in developing the implementation plan to the maximum extent practical. Public participation will significantly affect public acceptance of the document and the proposed control actions. Stakeholders (landowners, local governing authorities, taxpayers, industries, and land managers) are the most educated regarding the pollutant sources and will be responsible for implementing the control actions identified in the plan. Experience has shown that the best and most effective implementation plans are those that are developed with substantial public cooperation and involvement.

Adaptive Management Approach

The goal of the CWA and its associated administrative rules for Idaho is that water quality standards shall be met or that all feasible steps will be taken towards achieving the highest quality water attainable. This is a long-term goal in this watershed, particularly because nonpoint sources are the primary concern. To achieve this goal, implementation must commence as soon as possible.

The TMDL is a numerical loading that sets pollutant levels such that instream water quality standards are met and designated beneficial uses are supported. Idaho DEQ recognizes that the TMDL is calculated from mathematical models and other analytical techniques designed to simulate and/or predict very complex physical, chemical, and biological processes. Models and some other analytical techniques are simplifications of these complex processes and, while they are useful in interpreting data and in predicting trends in water quality, they are unlikely to produce an exact prediction of how streams and other waterbodies will respond to the application of various management measures. It is for this reason that the TMDL has been established with a MOS.

For the purposes of the Upper Owyhee Watershed TMDL, a general implementation strategy is being prepared for EPA as part of the TMDL document. Following this submission, in accordance with approved state schedules and protocols, a specific detailed implementation plan will be prepared for pollutant sources.

For nonpoint sources, Idaho DEQ also expects that implementation plans be implemented as soon as practicable. However, Idaho DEQ recognizes that it may take some period of time, from several years to several decades, to fully implement the appropriate management practices. Idaho DEQ also recognizes that it may take additional time after implementation has been accomplished before the management practices identified in the implementation plans become fully effective in reducing and controlling pollution. In addition, Idaho DEQ recognizes that technology for controlling nonpoint source pollution is, in many cases, in the development stages and will likely take one or more iterations to develop effective techniques. It is possible that after application of all reasonable best management practices, some TMDLs or their associated targets and surrogates cannot be achieved as originally established. Nevertheless, it is Idaho DEQ's expectation that nonpoint sources make a good faith effort to achieving their respective load allocations in the shortest practicable time.

Idaho DEQ recognizes that expedited implementation of TMDLs will be socially and economically challenging. Further, there is a desire to minimize economic impacts as much as possible when consistent with protecting water quality and beneficial uses. Idaho DEQ further recognizes that, despite the best and most sincere efforts, natural events beyond the control of humans may interfere with or delay attainment of the TMDL and/or its associated targets and surrogates. Such events could be, but are not limited to floods, fire, insect infestations, and drought.

For some pollutants, pollutant surrogates have been defined as targets for meeting the TMDLs. The purpose of the surrogates is not to bar or eliminate human access or activity in the basin or its riparian areas. It is the expectation, however, that the specific implementation plan will address how human activities will be managed to achieve the water quality targets and surrogates. It is also recognized that full attainment of pollutant surrogates (system potential vegetation, for example) at all locations may not be feasible due to physical, legal, or other regulatory constraints. To the extent possible, the implementation plan should identify potential constraints, but should also provide the ability to mitigate those constraints should the opportunity arise. If a nonpoint source that is covered by the TMDL complies with its finalized implementation plan, it will be considered in compliance with the TMDL.

Idaho DEQ intends to regularly review progress of the implementation plan. If Idaho DEQ determines the implementation plan has been fully implemented, that all feasible management practices have reached maximum expected effectiveness, but a TMDL or its interim targets have not been achieved, Idaho DEQ shall reopen the TMDL and adjust it or its interim targets and the associated water quality standard(s) as necessary.

The implementation of TMDLs and the associated plan is enforceable under the applicable provisions of the water quality standards for point and nonpoint sources by Idaho DEQ and other state agencies and local governments in Idaho. However, it is envisioned that sufficient initiative exists on the part of local stakeholders to achieve water quality goals with minimal enforcement. Should the need for additional effort emerge, it is expected that the responsible agency will work with land managers to overcome impediments to progress through education, technical support, or enforcement. Enforcement may be necessary in instances of insufficient action towards progress. This could occur first through direct intervention from state or local land management agencies, and secondarily through Idaho DEQ. The latter may be based on departmental orders to implement management goals leading to water quality standards.

In employing an adaptive management approach to the TMDL and the implementation plan, Idaho DEQ has the following expectations and intentions:

- Subject to available resources, Idaho DEQ intends to review the progress of the TMDLs and the implementation plans on a five-year basis.
- Idaho DEQ expects that designated agencies will also monitor and document their progress in implementing the provisions of the implementation plans for those pollutant sources for which they are responsible. This information will be provided to Idaho DEQ for use in reviewing the TMDL.
- Idaho DEQ expects that designated agencies will identify benchmarks for the attainment of TMDL targets and surrogates as part of the specific implementation plans being developed. These benchmarks will be used to measure progress toward the goals outlined in the TMDL.
- Idaho DEQ expects designated agencies to revise the components of their implementation plan to address deficiencies where implementation of the specific management techniques are found to be inadequate.
- If Idaho DEQ, in consultation with the designated agencies, concludes that all feasible steps have been taken to meet the TMDL and its associated targets and surrogates, and that the TMDL, or the associated targets and surrogates are not practicable, the TMDL may be reopened and revised as appropriate. Idaho DEQ would also consider reopening the TMDL should new information become available indicating that the TMDL or its associated targets and/or surrogates should be modified.

Monitoring and Evaluation

The objectives of a monitoring effort are to demonstrate long-term recovery, better understand natural variability, track implementation of projects and BMPs, and track effectiveness of TMDL implementation. This monitoring and feedback mechanism is a major component of the "reasonable assurance of implementation" for the TMDL implementation plan.

The implementation plan will be tracked by accounting for the numbers, types, and locations of projects, BMPs, educational activities, or other actions taken to improve or protect water quality. The mechanism for tracking specific implementation efforts will be annual reports to be submitted to Idaho DEQ.

The "monitoring and evaluation" component has two basic categories:
- Tracking the implementation progress of specific implementation plans; and
- Tracking the progress of improving water quality through monitoring physical, chemical, and biological parameters.

Monitoring plans will provide information on progress being made toward achieving TMDL allocations and achieving water quality standards, and will help in the interim evaluation of progress as described under the adaptive management approach.

Implementation plan monitoring has two major components:
- Watershed monitoring and

- BMP monitoring.

While Idaho DEQ has primary responsibility for watershed monitoring, other agencies and entities have shown an interest in such monitoring. In these instances, data sharing is encouraged. The designated agencies have primary responsibility for BMP monitoring.

Watershed Monitoring

Watershed monitoring measures the success of the implementation measures in accomplishing the overall TMDL goals and includes in-stream monitoring. Monitoring of BMPs measures the success of individual pollutant reduction projects. Implementation plan monitoring will also supplement the watershed information available during development of associated TMDLs and fill data gaps.

In the Upper Owyhee Watershed TMDL, watershed monitoring has the following objectives:

- Evaluate watershed pollutant sources,
- Refine baseline conditions and pollutant loading,
- Evaluate trends in water quality data,
- Evaluate the collective effectiveness of implementation actions in reducing pollutant loading to the mainstem streams and/or tributaries, and
- Gather information and fill data gaps to more accurately determine pollutant loading.

BMP/Project Effectiveness Monitoring

Site or BMP-specific monitoring may be included as part of specific treatment projects if determined appropriate and justified, and will be the responsibility of the designated project manager or grant recipient. The objective of an individual project monitoring plan is to verify that BMPs are properly installed, maintained, and working as designed. Monitoring for pollutant reductions at individual projects typically consists of spot checks, annual reviews, and evaluation of advancement toward reduction goals. The results of these reviews can be used to recommend or discourage similar projects in the future and to identify specific watersheds or reaches that are particularly ripe for improvement.

Evaluation of Efforts over Time

Annual reports on progress toward TMDL implementation will be prepared to provide the basis for assessment and evaluation of progress. Documentation of TMDL implementation activities, actual pollutant reduction effectiveness, and projected load reductions for planned actions will be included. If water quality goals are being met, or if trend analyses show that implementation activities are resulting in benefits that indicate that water quality objectives will be met in a reasonable period of time, then implementation of the plan will continue. If monitoring or analyses show that water quality goals are not being met, the TMDL implementation plan will be revised to include modified objectives and a new strategy for implementation activities.

Implementation Time Frame

The implementation plan must demonstrate a strategy for implementing and maintaining the plan and the resulting water quality improvements over the long term. The timeline should be as specific as possible and should include a schedule for BMP installation and/or evaluation, monitoring schedules, reporting dates, and milestones for evaluating progress. There may be disparity in timelines for different subwatersheds. This is acceptable as long as there is reasonable assurance that milestones will be achieved.

The implementation plan will be designed to reduce pollutant loads from sources to meet TMDLs, their associated loads, and water quality standards. Idaho DEQ recognizes that where implementation involves significant restoration, water quality standards may not be met for quite some time. In addition, Idaho DEQ recognizes that technology for controlling nonpoint source pollution is, in some cases, in the development stages and will likely take one or more iterations to develop effective techniques.

A definitive timeline for implementing the TMDL and the associated allocations will be developed as part of the implementation plan. This timeline will be developed in consultation with the WAG, the designated agencies, and other interested publics.

5. Total Maximum Daily Load

A TMDL prescribes an upper limit on discharge of a pollutant from all sources so as to assure water quality standards are met. It further allocates this load capacity (LC) among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation (WLA); and nonpoint sources, which receive a load allocation (LA). Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (40 CFR § 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the MOS is a reduction in the load capacity that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the load capacity available for allocation to human made pollutant sources. This can be summarized symbolically as the equation: LC = MOS + LA + WLA = TMDL. The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First the load capacity is determined. Then the load capacity is broken down into its components: the necessary MOS is determined and subtracted and then the remainder is allocated among pollutant sources. When the breakdown and allocation is completed we have a TMDL, which must equal the load capacity.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. Also a required part of the loading analysis is that the load capacity be based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both load capacity and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear on the surface.

A load is fundamentally a quantity of a pollutant discharged over some period of time, and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for “other appropriate measures” to be used when necessary. These “other measures” must still be quantifiable, and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads, and allow “gross allotment” as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads.

The Upper Owyhee Watershed has no point source discharges. All loads are associated with nonpoint sources and the TMDLs will be written for nonpoint sources only. No waste load allocations will be developed.

5.1 Instream Water Quality Targets

The in-stream water quality targets for the water quality limited segments within the Upper Owyhee Watershed TMDL are to provide full support for the designated and existing uses (IDAPA§ 58.01.02.054.02).

Through the Upper Owyhee Watershed SBA it has been determined temperatures are exceeding state of Idaho WQS. Water temperature data showed the criteria for the protection of CWAL and salmonid spawning were exceeded during critical periods. Analysis of biological communities showed sediment was impairing the biota of the stream substrate in Castle Creek, Deep Creek, and Nickel Creek. Turbidity levels in Juniper Basin and Blue Creek Reservoirs exceeded literature values, which the state of Idaho WQS are based on for the protection of CWAL. Both the temperature criteria and the turbidity criteria are set at levels to establish a threshold to maintain or restore existing or designated uses. Table 29 shows the targets to achieve WQS.

Table 29. Water Quality Targets for the Water Quality Limited Segments. Upper Owyhee Watershed.

Pollutants	Water Bodies	Selected Targets
Sediment	Juniper Basin Reservoir Blue Creek Reservoir Deep Creek Castle Creek Nickel Creek	**For Reservoirs:** Turbidity no greater than 25 NTU **For Streams:** TSS no greater than 50 mg/l as a monthly average and no greater than 80 mg/l lasting more than 14 days **Stream Substrate:** Substrate composed of fine sediment of less than 6 mm for no greater than 30% of given area of stream substrate, confined to riffle areas **Stream Bank Erosion Rates:** As defined by load capacity
Temperature	Deep Creek Pole Creek Castle Creek Red Canyon Creek	**Salmonid Spawning:** Water temperatures of 13° C or less with a maximum daily average no greater than 9° C **Cold Water Aquatic Life:** Water temperatures 22° C degrees C or less with a maximum daily average of no greater than 19°C. **Shade Component:** Shade required to meet targets as determined through the use of the SSTEMP[a] model

a Stream Segment Temperature Model (Barthlow 1999)

<u>Design Conditions</u>

The critical time periods for maintaining cool waters is during the summer months, mainly June through August when warm ambient air temperatures and solar radiation have the greatest impact on water temperature. The general salmonid spawning period is from March 15, through July 15 (Idaho DEQ 2001). Most water temperature data indicate the period from June 1 through July 1 is the critical period for salmonid egg development and fry emergence in the streams in the Upper Owyhee Watershed. Water temperature was predicted through the Stream Segment Temperature Model (SSTEMP) (Bartholow 1999) and the hydrology, or predicted discharge was, determined through the U.S. Geological Survey (USGS) model developed by Hortness and Berenbrock (2001). Through the discharge model, low flows at “Q.80” were determined. This flow of Q.80 represents the predicted flow at 80% of the exceedance of the monthly baseflow. Once the Q.80 was determined, the standard error of estimate was used to determine the lowest possible flow calculated by the model. This low flow was then applied to the SSTEMP model as a means of determining the most critical period for water temperature. Explanation of the models used and validations are located in Appendix D.

Sediment, both suspended and bedload, appears to be critical in a year-round loading analysis. Suspended sediment has impaired CWAL by interfering with the filter feeding capability of macroinvertebrates, while bedload sediment has reduced the amount of available interstitial space of the substrate. This space is required for salmonid spawning (redd construction), fry development, and habitat for macroinvertebrates.

To determine sediment loading, the discharge model developed by Hortness and Berenbrock (2001) was used. Each month's mean discharge was calculated and used for the load analysis.

The major components of nonpoint source management are implementing remedial activity and maintaining that activity. Although the critical periods may be during the summer months, year round management is key to achieve the goals and targets. The response time to changes in management practice will take 20-100 years in some places. The presence and maintenance of good plant vigor, stable streambanks, and stream morphology are important components of the temperature and sediment TMDLs and are required to be maintained during non-critical periods.

Monitoring Points

Monitoring points should follow stations established in the Upper Owyhee Watershed Monitoring Plan (Ingham 2000). However, as land management agencies develop land use plans for each particular land use, monitoring should be conducted to determine BMP effectiveness and compliance with TMDL goals and targets. Since some of the established monitoring points are located on private holdings, permission to enter these sites should be established. Monitoring sites on public lands will be the responsibility of the appropriate land management agency.

Monitoring parameters should include: instream water column TSS (Ralston 1978), stream substrate fine sediment (Burton 1991), flow (Ralston 1978), canopy density (Burton 1991), topographic shading (Burton 1991), stream bank erosion rates (NRCS 1983) and temperature logger placement (Zaroban 2000).

For the two reservoirs, Blue Creek and Juniper Basin, a literature value protecting CWAL of 25 NTUs was chosen as the target. Turbidity monitoring on Mountain View Reservoir on the Shoshone-Paiute Duck Valley Indian Reservation may provide a reference level that could be incorporated into a modification of the TMDL. However, the allocation for turbidity and a MOS will be set. Changes to the TMDL may be made as more information is collected.

Seasonal Variation

The TMDL must account for critical conditions and seasonal variations. In this case, the analysis is based on both critical conditions and seasonal variability, the periods when water temperatures are exceeding state WQS. The two periods include salmonid spawning (spawning and incubation) and CWAL. The temperature analysis was also based on the lowest flow determined by the use of the discharge model (Hortness and Berenbrock 2001), which accounts for the most critical condition. Seasonal variations were also accounted for by analyzing the monitoring data and then focusing on the period of highest temperatures during late spring and early to mid summer.

The TMDL must also account for critical conditions and seasonal variation for sediment delivery. For streams and reservoirs, it is inherently a non-seasonal phenomenon with a disproportionate amount of erosion associated with snowmelt (December through May) and heavy precipitation events, which can occur throughout the year. Sediment delivery is also variable on an annual basis, with erosion rates dependent from year to year on storm events, snow melt duration and winter snowpack. To account for this annual variability, the TMDL and load allocations are expressed as a yearly average. Similarly, the approach used in this TMDL is to identify indicators that are reflective of the net effects from year to year.

5.2 Load Capacity

Capacity, or load capacity is defined as the greatest amount of loading that a water can receive without violating water quality standards (40 CFR §130.2(f)).

Temperature (Heat) Load Capacity

The temperature TMDL will establish a water temperature capacity and reduction requirements based on the numeric criteria in the state Idaho WQS. Target selection is based on a mass/unit/time measurement of joules/meter^2/second (joules/m^2/sec). The SSTEMP model (Bartholow 1999) was utilized to determine the reduction of joules/m^2/sec required to achieve state of Idaho WQS. The SSTEMP model also indicates the amount of shade required to obtain the desired joules/m^2/sec. Thus, the load capacity will use the mass/unit/time measurement and the surrogate measure of percent shading. Appendix D describes the SSTEMP results plus the validation methods used. Table 30 shows the temperature load capacity for the water quality limited segments. Not all segments listed are §303(d) listed segments. However, for the month of June, the SSTEMP model indicated upstream water temperature reductions needs to occur if temperature load capacities are to be met in listed segments.

To address the heat loading capacity, a surrogate measurement of percent shade is utilized. The shading capacity is determined by the amount of joules/meter^2/sec capacity. As the amount of shade increases, the amount of heat exchange to the water body decreases. Table 31 shows predicted percent shade required to achieve WQS on §303(d) listed segments and on those segments not on the §303(d) list.

A simple definition of temperature exchange from hot to cold material is the form of heat. Heat is not defined as the energy itself, but the capability to transfer energy from one source to another based on temperature, hot to cold. The “Le Systeme International d’ Unites” or “SI” for energy is the joule. The joule is the measurement of “work,” “kinetic energy” or “potential energy.” Thus, the use of the term joule(s) within this document is in reference to the exchange of energy from one source to another (Cutnell and Johnson 1989).

A simple relation between heat (energy) and temperature can be seen in the following formula (Cutnell and Johnson 1989):

$$Q = cm \quad T$$

where Q = Heat (energy)
c = specific heat capacity
m = mass
T = delta temperature (= an increment of a variable)

As temperature changes, the amount of energy or heat, flows from the hotter mass to the colder mass. As an example, a glass of water at room temperature is placed in a refrigerator. Since energy "flows" from hotter to colder, energy from the warmer water flows to the colder air within the refrigerator causing the a loss of energy within the water resulting in colder water. Thus, an overall loss of energy from the water.

Heat exchange between water and the environment can be affected by a variety of factors, including physical and atmospheric attributes. These factors influence the overall heat fluxes (gain or loss) in the water. Figure 16 shows a schematic of how heat fluxes that may affect the transfer of heat in a water body.

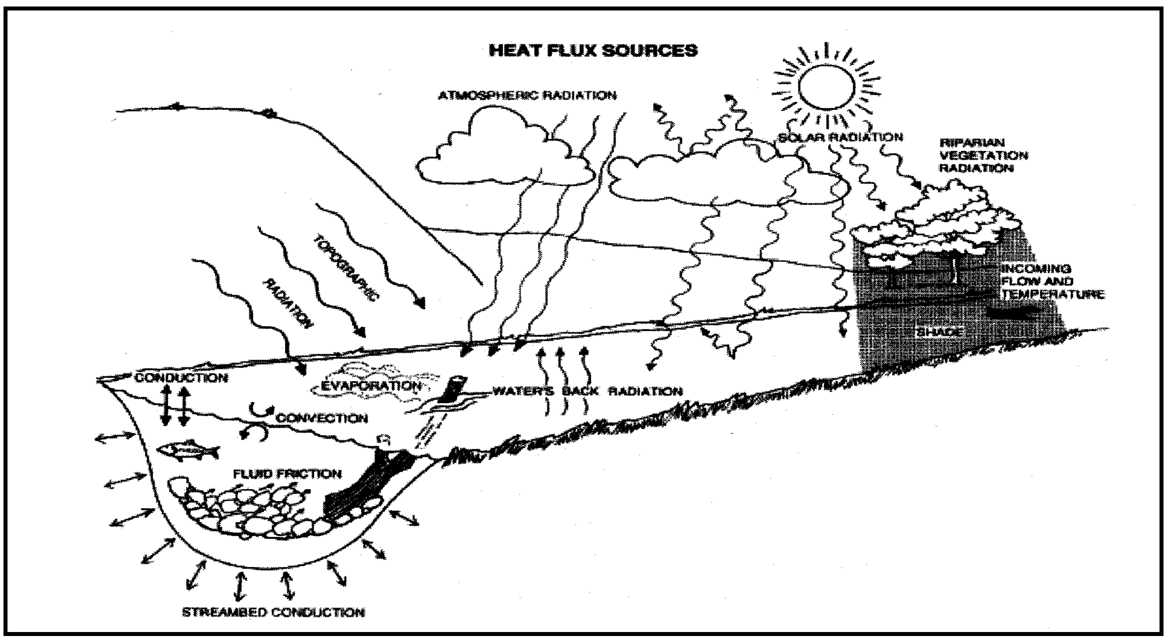


Figure 16. Possible Heat Flux Sources (Re-Printed from Bartholow 1999). Upper Owyhee Watershed.

Table 30 indicates that some load capacity a negative value for joules/m^2/sec. This negative value is an overall sum of the different net mean heat fluxes losses or gains. The mean heat fluxes are governed by a variety of factors including convection, conduction, evaporation, backwater radiation, atmosphere, friction, solar radiation and vegetation component. The SSTEMP model (Bartholow 1999) generates these values based on input from other parameters. A negative value produced by the model indicates that there is a negative heat flux based on the input values entered. In other words, the negative value would indicate there is a greater loss of heat than heat gain (a loss of energy). Thus, temperature would decrease based on the values entered. This provides the required link between heat source and shade.

It should be remembered that the SSTEMP model provides for a gross estimate of heat loss or gains brought on by changing vegetation shade. There are many unknowns to determine what increase vegetation may have on channel width, channel length, air temperature, relative humidity, wind speed or other physical/climatic attributes that will affect water temperature. SSTEMP is only as reliable as the data entered. Thus, as more information is collected, the model can be re-calibrated to reflect certain segment actual conditions.

On Table 31 shading requirements (load capacity) vary from month to month, with the highest percent shade required in June. This higher shade requirement for June is a result of a much lower temperature criteria (9^{o}C) that must be met. Thus, a greater amount of solar radiation reduction is required. For July and August the criteria to be met is 22^{o}C or less (maximum daily temperature). The SSTEMP model does have limitations for estimating maximum daily temperatures. However, the model does provide a starting point for further evaluations. The model predicted the shade component is not as great as required in June. Both July and August are shown as a comparison. The month of July shows the most stringent level of heat reduction required to achieve criteria of 22^{o}C and the support of CWAL.

Table 30. Heat Load Capacity for Cold Water Aquatic Life, Salmonid Spawning and Incubation Periods. Load Capacity Support for Stream Segments. Upper Owyhee Watershed.

Stream[a]	June Load Capacity SS[b] Criteria of 9°C MDAT[c] joules/m²/sec	July Load Capacity CWAL[d] Criteria of 22°C MDT[e] joules/m²/sec	August Load Capacity CWAL Criteria of 22°C MDT joules/m²/sec	Method of Estimated[f]
Upper Deep Creek	5.34	68.46	85.49	SSTEMP
Middle Deep Creek	4.87	55.06	24.16	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	6.47	16.25	148.16	SSTEMP
Lower Deep Creek	0.87	15.88	-52.25	SSTEMP
Upper Pole Creek	37.67	457.31	432.10	SSTEMP
Lower Pole Creek	3.52	46.26	47.76	SSTEMP
Castle Creek	44.06	470.49	468.64	SSTEMP
Red Canyon	40.73	473.40	391.34	SSTEMP
Nickel Creek	58.31	475.02	349.33	SSTEMP
Hurry Back Creek	52.49	481.22	352.87	SSTEMP
Nip and Tuck Creek	75.00	486.22	352.87	SSTEMP
Current Creek	53.18	438.08	356.41	SSTEMP
Camas Creek	32.64	444.84	336.76	SSTEMP
Camel Creek	35.69	448.66	377.48	SSTEMP
Bull Gulch	33.64	450.10	338.86	SSTEMP
Beaver Creek	43.87	467.67	345.16	SSTEMP
Upper Dickshooter Creek	28.39	448.37	339.21	SSTEMP
Lower Dickshooter Creek	82.81	93.40	46.57	SSTEMP

Bold = 1998 ä303(d) Listed Segments,b. salmonid spawning, c. maximum daily avergae temperature, d. cold water aquatic life,e.maximum daily Temperature, f. .Stream Segment Temperature Model (Bartholow 1999)

Table 31. Shade Requirements to Achieve Load Capacity for Stream Segments. Upper Owyhee Watershed.

Stream[a]	June Load Capacity SS[b] Criteria of 9°C MDAT[c] Percent Shade	July Load Capacity CWAL[d] Criteria of 22°C MDT[e] Percent Shade	August Load Capacity CWAL Criteria of 22°C MDT Percent Shade	Method of Estimate[f]
Upper Deep Creek	100	52	59	SSTEMP
Middle Deep Creek	100	57	57	SSTEMP
Lower Deep Creek	100	66	67	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	100	58	57	SSTEMP
Upper Pole Creek	96	96	58	SSTEMP
Lower Pole Creek	100	65	60	SSTEMP
Castle Creek	95	95	58	SSTEMP
Red Canyon Creek	94	94	57	SSTEMP
Nickel Creek	88	88	56	SSTEMP
Hurry Back Creek	92	95	54	SSTEMP
Nip & Tuck Creek	87	87	54	SSTEMP
Current Creek	91	91	53	SSTEMP
Camas Creek	98	98	61	SSTEMP
Camel Creek	97	97	62	SSTEMP
Bull Gulch	98	98	62	SSTEMP
Beaver Creek	97	97	59	SSTEMP
Upper Dickshooter Creek	100	100	62	SSTEMP
Lower Dickshooter Creek	94	65	67	SSTEMP

Bold = 1998 ä303(d) Listed Segments, b. salmonid spawning, c. maximum daily average temperature, d. cold water aquatic life, e.maximum daily temperature, f. .Stream Segment Temperature Model (Bartholow 1999)

Sediment Load Capacity

Idaho utilizes a narrative standard for sediment. The standard states, "Sediment shall not exceed quantities specified in Sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in

Section 350" (IDAPA §58.01.02.200.08). The water bodies that have been determined to be impaired by sediment are required to be addressed through the TMDL process, IDAPA §58.01.02.054.02 (Section 2.3 and 2.4). The TMDL process will establish a sediment TMDL based on three criteria; percent fines as related to substrate, water column sediment load and turbidity. The numeric load capacity for these three parameters have been established based on literature review and/or sediment load capacities established in other TMDL developed by the state of Idaho. The load capacity as defined earlier describes the greatest amount of loading that a water can receive without violating water quality standards (40 CFR §130.2(f)).

Water Column Load

The targets set for water column load is based on values obtained from TMDLs developed in watersheds with similar characteristics (e.g. Bruneau River, Idaho DEQ 2000*d*). For the streams that enter into reservoirs, stream sediment load capacity will be based on water column loading at 50 mg/l for a monthly average and/or 80 mg/l not to exceed fourteen days. Table 32 provides load capacity for water bodies that flow into the reservoirs, along with the other water bodies with a TMDL required to address sediment. It should be noted that the water bodies upstream of the reservoirs are not impaired by sediment, but are sources of sediment to the reservoirs.

Table 32. Sediment Load Capacity for Stream Segments. Upper Owyhee Watershed.

Stream	Flows[a] (cfs)	Load Capacity at 50 TSS[b] mg/l (tons/year)	Load Capacity at 80 TSS mg/l (tons/year)	Method of Estimation[c]
Deep Creek	52.0	2555	4088	Flow Concentration
Castle Creek	11.8	579	927	Flow Concentration
Nickel Creek	0.39	19	31	Flow Concentration
Blue Creek above Blue Creek Reservoir	6.74	331	530	Flow Concentration
Juniper Creek above Juniper Basin Reservoir	1.96	96	154	Flow Concentration

Discharge Determined by Hortness and Borenbrook 2001, annual discharge rate, b. Total Suspended Solids, c. Standards Methods 18th Edition

Surrogate Targets

The surrogate targets do not easily fit the mass/unit/time definition as described in 40 CFR 130.2(i). However, description of the current condition of the targets may be appropriate.

Substrate Targets

For sediment, the primary determination a beneficial use is impaired was through the use of biological indicator species, periphyton and macroinvertebrates (Clark 2001 and Bahls 2000 and 2001). A study conducted by Idaho State University (Relyea, Minshall and Danehy 2000) has provided a link between a biological indicator and a physical attribute of stream morphology, stream substrate and percent fines. The Relyea, Minshall and Danehy (2000) study indicated that a threshold of greater than 30% of the substrate of less than 6mm would produce Plecoptera (stoneflys) that are tolerant of sediments. Substrate less than 30% produced species that are more intolerant of sediment. With these biological indicators in mind, and a sediment link that has been developed for the state of Idaho, the targets recommended by Relyea, Minshall and Danehy (2000) is an appropriate surrogate to determine the loading capacity as related to sediment loading. Percent fines substrate targets are presented in Table 33.

Table 33. Percent Fine Load Capacity. Upper Owyhee Watershed.

Stream	Load Capacity 30%[a]
Deep Creek	30%
Nickel Creek	30%
Castle Creek	30%

<6 mm

Turbidity Targets

With the determination CWAL is impaired in both water bodies, a load capacity is required to be established (IDAPA §58.01.02.054.02) (Bahls 2000 and 2001). Most literature values indicate turbidity levels above 25 NTUs impair beneficial uses (Lloyd 1987, Sigler et al. 1984 and Bash, Berman and Bolton 2001). Table 34 shows the load capacity for turbidity.

Table 34. Turbidity Load Capacity for Reservoirs. Upper Owyhee Watershed.

Stream	Load Capacity (NTUs)[a]
Blue Creek Reservoir	25
Juniper Basin Reservoir	25

a. Nephelometric Turbidity Unit

Streambank Targets

The water column targets set for water bodies, either the streams that flow into the reservoirs or the other impaired streams, provide for a link to the pollutant source, streambanks. As demonstrated in Table 32, a mass/unit/time capacity is formulated. With a set annual load capacity in tons/year a surrogate target can be established for streambank erosion, tons/mile/year. This is a linear measurement of streambank stability and a quantity target for streambank erosion rates. The surrogate measurement for streambank load capacity is located in Table 35.

The water column targets set for water bodies, either the streams that flow into the reservoirs or the other impaired streams, provide for a link to the pollutant source, streambanks.

Table 35. Target Stream Bank Load Capacity for Stream Segments. Upper Owyhee Watershed.

Stream	Stream Bank Erosion Rate Load Capacity at 50 mg/l (tons/mile/year)	Method of Estimation[a&b]
Deep Creek	9.7	Flow Concentration, NRCS 1983
Castle Creek	48.3	Flow Concentration, NRCS 1983
Nickel Creek	10.6	Flow Concentration, NRCS 1983
Blue Creek above Blue Creek Reservoir	8.8	Flow Concentration, NRCS 1983
Juniper Creek above Juniper Basin Reservoir	3.8	Flow Concentration, NRCS 1983

a. Standards Methods 18th Edition, b.Natural Resource Conservation Sevice

5.3 Estimates of Existing Pollutant Load

Estimate of Existing Temperature (Heat) Loading

Current loads for temperature are estimated with the use of Hortness and Berenbrock (2001) discharge model and the SSTEMP (Bartholow 1999) temperature model. Regulations allow that loading "…may range from reasonably accurate estimates to gross allotments, depending on the available of data and appropriate techniques for predicting the loading (40 CFR §130.2(I)). The SSTEMP model has been incorporated into previous temperature TMDLs (Washington Department of Ecology 2001). The SSTEMP model has proven to provide adequate gross allotments.

Existing solar radiation and heat transfer are represented in the current load in joules/m^2/second. However, the current load of joules/m^2/second is not totally representative of all reaches where temperature analyses were preformed. Topographic shading estimates were taken from 7.5-minute topographic maps for different segments. In some situations the topographic shade made up 35% of the total shade component. Current vegetation shade was usually placed at zero with the idea that once more information is gathered the implementation of BMPs for that segment can be adjusted. However, even without this high amount of uncertainty, the load capacity will not change.

Azimuth siting is based on the general higher elevation to lower elevation aspect. Most segments have meanders that will change the aspect, but generally these changes in aspect are minor and the overall aspect (usually north to south) was a steady state input for the entire reach. Stream width and depth parameters were set near conditions found throughout the Upper Owyhee Watershed by BURP evaluations. This setting was near a ratio of 25:1. Width-depth ratios were then adjusted to near 12:1 for the final analysis to compensate for future changes in stream morphology caused by increased vegetation and bank stability. It should be pointed out the changes in width-depth ratio without changes to vegetation cover produced some change in the amount of heat transfer and some change in water temperature. An average reduction of less than 0.7 ^{o}C in daily average maximum and minimum temperatures was noted.

Overall the use of the SSTEMP model provided an adequate estimate of the current heat load to segments impaired by temperature. Table 36 shows the estimated existing load.

Table 36. Estimated Existing Heat Load in Stream Segments. Upper Owyhee Watershed.

Stream[a]	Existing Load June joules/m^2/sec	Existing Load July joules/m^2/sec	Existing Load August joules/m^2/sec	Method of Estimation[b]
Upper Deep Creek	20.81	11.36	32.68	SSTEMP
Middle Deep Creek	27.52	51.60	35.21	SSTEMP
Lower Deep Creek	8.37	15.54	-41.42	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	25.56	27.54	35.21	SSTEMP
Upper Pole Creek	241.66	566.77	432.10	SSTEMP
Lower Pole Creek	5.62	52.46	-0.83	SSTEMP
Castle Creek	274.04	607.76	468.64	SSTEMP
Red Canyon	191.21	523.71	391.34	SSTEMP
Nickel Creek	190.91	520.37	390.37	SSTEMP
Hurry Back Creek	246.21	571.11	446.76	SSTEMP
Nip & Tuck Creek	242.46	568.79	429.09	SSTEMP
Current Creek	191.91	523.40	391.09	SSTEMP
Camas Creek	260.69	588.57	442.25	SSTEMP
Camel Creek	235.30	567.07	428.34	SSTEMP
Bull Gulch	191.66	569.56	448.17	SSTEMP
Beaver Creek	273.29	607.14	468.07	SSTEMP
Upper Dickshooter Creek	274.12	591.40	468.46	SSTEMP
Lower Dickshooter Creek	83.39	112.68	28.26	SSTEMP

a. 1998 ä303(d) Listed Segments, b. Stream Segment Temperature Model (Bartholow, 1999)

Estimate of Existing Sediment Loading

Water Column Loading

Estimating sediment loads in the Upper Owyhee has proven more difficult. Little to no data and with limited access too many segments have compounded the difficulties in estimating existing loading. The use of the USGS annual streamflow model (Hortness and Berenbrock 2001) does provide a gross estimate of flows that may be found in streams and rivers in the Upper Owyhee Watershed. With available flow estimates, load capacity targets can be made based on expected sediment concentration recommendations. The values of 80 mg/l and 50 mg/l represent in-stream water quality targets that have been incorporated into other sediment TMDLs in the state of Idaho (e.g., Lower Boise River TMDL and Bruneau River TMDL). It is believed the use of these concentration levels provides an adequate estimate to protect existing uses in the Upper Owyhee Watershed.

However, to establish a current sediment load based on in-stream water column loads is impossible. Data is available to provide a gross estimate based on streambank erosion found in the Succor Creek watershed and provided by a study completed for a TMDL for that watershed (HUC 17050103). Horsburgh (2002) found current streambank erosion rates in the watershed were between 13 to 215 tons/mile/year. Table 37 shows the gross estimates of possible in-water column sediment concentrations for those streams required to have a sediment load allocation. These concentrations are based on low and high yield estimates from stream bank erosion rates of 13 to 214 tons/mile/year.

Table 37. Estimated In-Stream Concentrations based on Streambank Erosion. Upper Owyhee Watershed.

Stream	Miles of 2nd and Larger Order Streams	Estimated Flow[a] cfs	Estimated Concentration Low Yield at 13 tons/mile/year (mg/l)	Estimated Concentration High Yield at 214 tons/mile/year (mg/l)	Method of Estimation
Deep Creek	262.6	52.0	67	1098	Based on probable bank erosion yields of 13-214 tons/mile/year
Castle Creek	12.0	11.8	13	218	Based on probable bank erosion yields of 13-214 tons/mile/year
Nickel Creek	1.8	0.4	59.7	983	Based on probable bank erosion yields of 13-214 tons/mile/year
Blue Creek above Blue Creek Reservoir	37.7	6.7	49.4	814	Based on probable bank erosion yields of 13-214 tons/mile/year
Juniper Creek above Juniper Basin Reservoir	25.0	2.0	250	4114	Based on probable bank erosion yields of 13-214 tons/mile/year

a Flow from Hortness and Borenbrook (2001)

The data presented in Table 37 does not accurately show the actual loading and many assumptions would have to occur. Mainly, erosion rates would be equal throughout the 2nd order water bodies for any given stream. Secondly, the flow rates used to calculate the estimated sediment concentrations are an annual discharge rate. Discharge rates can vary greatly depending on a variety of factors such as storm events, snow melt, drought conditions and other meteorological and physical conditions. However, the data presented does show the wide variability of sediment load that could be encountered through streambank erosion.

The data in Table 37 does not represent possible sediment load from overland sources and would only represent streambank sources. Overland soil erosion rates have been determined using the modified universal soil loss equation as prepared by the BLM during the development of the RMP (Seronko 2002). This study provided some computed values for expected soil erosion rates in the Upper Owyhee Watershed. However, the general overall soil loss is broken down for an entire watershed and does not take into account different landforms such as stream channels. Also, the erosion rate determined by the ORMP only indicates soil movement and not delivery rates to surface waters. As noted in Table 38, overland soil erosion in the Upper Owyhee Watershed could exceed the load capacity by 30 to 790 times for both the 50 mg/l and 80 mg/l targets.

In the Upper Owyhee Watershed it is expected that streambank erosion is the largest contributor to surface water sediment loads. As more stream bank information and more accurate overland erosion delivery rates are collected by land management agencies, the value presented in Tables 37 and 38 will be adjusted.

Table 38. Estimated Overland Erosion. Upper Owyhee Watershed.

Stream	Watershed Total Size (acres)	Estimated High Yield at 2.4 tons/year (tons/year)	Estimated Low Yield at 1.1 tons/year (tons/year)	Method of Estimation
Deep Creek	275,563	661,351	303,119	MUSLE, Seronko, 2002
Castle Creek	15,372	36,893	16,909	MUSLE, Seronko, 2002
Nickel Creek	2,070	4,968	2,277	MUSLE, Seronko, 2002
Blue Creek above Blue Creek Reservoir	39,224	94,138	58,356	MUSLE, Seronko, 2002
Juniper Creek above Juniper Basin Reservoir	53,051	127,322	43,146	MUSLE, Seronko, 2002

a Modified Universal Soil Loss Equation

Surrogate Targets

The surrogate targets do not easily fit the mass/unit/time definition as described in 40 CFR 130.2(i). However, description of the current condition of the targets may be appropriate.

Substrate

Data collected from the various BURP monitoring sites along with the various monitoring dates indicated that stream substrate percent fines (<6mm) varied from 15% to 55%. Most of the sites that had SMI scores that indicated the streams were not fully supporting CWAL had percent fines (<6mm) greater than 30%. More information will be required to determine the site potential for different segments that will have a stream substrate target established.

Turbidity

Turbidity levels collected in 2001 showed a level of 65 NTUs for Blue Creek Reservoir and 70 NTUs for Juniper Basin Reservoir. The estimate for the possible existing loading from upstream sources is described in Tables 37 and 38.

5.4 Allocation

All pollution sources are from nonpoint or natural sources. Allocations will be based on land use, which in the majority of the Upper Owyhee Watershed consists of rangeland. For sediment allocations riparian areas have been calculated, but represent a small portion of the land use in the sub-watersheds. Forested areas within the watershed do not contain harvestable types of timber. Thus, forest practices are not an issue and those areas identified as forested are incorporated into the primary land use of rangeland. This designation would only effect the sediment allocation in the Deep Creek and Castle Creek subbasins where forested land use makes up approximately 28% and 32% respectively. Juniper Basin and Blue Creek do not contain any forested areas. As with sediment, allocations for temperature reductions will be based on the single land use of rangeland.

Margin of Safety

The Clean Water Act and its regulations require a MOS to address uncertainty in the TMDL. For temperature, certain amounts of conservative assumption are built into the TMDL to apply an implicit MOS. For the temperature TMDL, conservative assumptions concerning physical attributes other than increased shade were made that may account for uncertainties in the model analysis that provide for a MOS:

Temperature

Enhancement of streambank vegetation will promote bank stability creating better properly functioning stream morphology. This will increase ground water supply and the hyporheic flow conditions with a reduction in water temperature. These effects were not accounted for in the temperature analysis.

The SSTEMP model has limitations for streams that may be gaining or losing reaches. Reaches that gain through groundwater recharge offer cold water refugia for CWAL. These effects were not accounted in the temperature analysis.

The reestablishment of access to a floodplain will enhance stream morphology. With the potential to develop a flood plain, stream conditions will allow for more sinuosity, decreased width-depth ratio and higher frequency of pools, which offer cooler refuge areas for CWAL. These effects were not accounted in the temperature analysis.

Reduced sediments can be expected to increase pool depth and pool frequency. This increase will also provide offer cooler refuge areas for CWAL. These effects were not accounted in the temperature analysis.

The flow model utilized determines flows at the most critical low flow periods. Along with the critical flow conditions that may be encountered, the critical condition analysis and model validation followed data collected during two years of drought conditions.. With increased available water in "normal" water years increased flows and lower water temperature can be expected than those observed in 2000 and 2001. These effects were not accounted in the temperature analysis.

Sediment

For sediment, some uncertainty and unknowns are present that would demonstrate a MOS is required. Some of these uncertainties include the lack of knowledge on the amount of sediment that is delivered to water bodies from upland sources, lack of data to demonstrate the existing load and what would constitute a natural loading. Another major unknown is the particular reach's streambank erosion rates, both induced and natural. Some reaches, especially in Deep Creek, may have erosion rates well below the target due to geology and stream morphology.

With these uncertainties, it is proposed that an explicit MOS of (10%) of the load capacity be applied to the sediment load allocation. The Bruneau River TMDL (Idaho DEQ 2000) established a similar MOS allocation. The MOS will be an allocation that can not be expected to be reduced, but as an allocation to the uncertainty of the total allocation to meet the load capacity. As more information is collected by land management agencies, the MOS may be adjusted to reflect the natural condition.

Remaining Available Load

The remaining load is the load allocation (LA). This load is to be allocated to the human induced nonpoint source pollutants. This component of the load capacity for the load allocation can be calculated by the following formula:

$$LC = MOS + WLA + LA + WLA = TMDL$$

Since there is no point source for the waste load allocation, the following formula is used to calculate the load allocation:

$$LC = LA + MOS = TMDL$$

For temperature there is an implicit MOS, therefore the MOS for temperature is zero. For sediment the MOS will be applied at 10% of the load capacity. Therefore the following formulas will be applied for temperature and sediment;

For temperature:

$$LA = LC = TMDL$$

For Sediment:

$$LA = LC - 10\% \text{ of } LC = TMDL$$

Temperature Load Allocations and Targets

For temperature, the entire load allocation is assigned to the current primary land use, rangeland. As defined in 40 CFR 130.2(i), the load allocation will be based in mass/per/unit/time. Table 39 shows the LA calculations in joules/m^2/sec for the temperature portion of the TMDL. However, the SSTEMP model provided surrogate targets that may be more useful for land management agencies and a more appropriate for site potential application. These targets are located in Table 40. Since the targets for water body shading are more stringent for June, this will be the target that will have to be met.

Table 39. June, July and August Load Allocation for Temperature. Upper Owyhee Watershed.

Stream[a]	Land Use	June Load Allocation SS[b] Criteria of 9°C MDAT[c] joules/m²/sec	July Load Allocation CWAL[d] Criteria of 22°C MDT[e] joules/m²/sec	August Load Allocation CWAL Criteria of 22°C MDT joules/m²/sec	Method of Estimate[f]
Upper Deep Creek	Rangeland	5.34	68.46	85.49	SSTEMP
Middle Deep Creek	Rangeland	4.87	55.06	24.16	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	Rangeland	6.47	16.25	148.16	SSTEMP
Lower Deep Creek	Rangeland	0.87	15.88	-52.25	SSTEMP
Upper Pole Creek	Rangeland	37.67	457.31	432.10	SSTEMP
Lower Pole Creek	Rangeland	3.52	46.26	47.76	SSTEMP
Castle Creek	Rangeland	44.06	470.49	468.64	SSTEMP
Red Canyon	Rangeland	40.73	473.40	391.34	SSTEMP
Nickel Creek	Rangeland	58.31	475.02	349.33	SSTEMP
Hurry Back Creek	Rangeland	52.49	481.22	352.87	SSTEMP
Nip and Tuck Creek	Rangeland	75.00	486.22	352.87	SSTEMP
Current Creek	Rangeland	53.18	438.08	356.41	SSTEMP
Camas Creek	Rangeland	32.64	444.84	336.76	SSTEMP
Camel Creek	Rangeland	35.69	448.66	377.48	SSTEMP
Bull Gulch	Rangeland	33.64	450.10	338.86	SSTEMP
Beaver Creek	Rangeland	43.87	467.67	345.16	SSTEMP
Upper Dickshooter Creek	Rangeland	28.39	448.37	339.21	SSTEMP
Lower Dickshooter Creek	Rangeland	82.81	93.40	46.57	SSTEMP

Bold = 1998 ä303(d) Listed Segments, b. salmonid spawning, c. Maximum Dauly Average Temperature, d.cold water aquatic life, e.Maximum Daily Temperature

Steam Segment Temperature Model (Bartholow 1999)

Table 40. Shade Requirements to Achieve Load Capacity for Stream Segments. Upper Owyhee Watershed.

Stream[a]	Land Use	June Load Allocations SS[b] Criteria Of 9°C MDAT[c] Percent Shade	July Load Allocations CWAL[d] Criteria of 22°C MDT[e] Percent Shade	August Load Allocations CWAL Criteria of 22°C MDT Percent Shade	Method of Estimate[f]
Upper Deep Creek	Rangeland	100	52	59	SSTEMP
Middle Deep Creek	Rangeland	100	57	57	SSTEMP
Lower Deep Creek	Rangeland	100	66	67	SSTEMP
Deep Creek below Nickel Creek to Pole Creek	Rangeland	100	58	57	SSTEMP
Upper Pole Creek	Rangeland	96	96	58	SSTEMP
Lower Pole Creek	Rangeland	100	65	60	SSTEMP
Castle Creek	Rangeland	95	95	58	SSTEMP
Red Canyon Creek	Rangeland	94	94	57	SSTEMP
Nickel Creek	Rangeland	88	88	56	SSTEMP
Hurry Back Creek	Rangeland	92	95	54	SSTEMP
Nip & Tuck Creek	Rangeland	87	87	54	SSTEMP
Current Creek	Rangeland	91	91	53	SSTEMP
Camas Creek	Rangeland	98	98	61	SSTEMP
Camel Creek	Rangeland	97	97	62	SSTEMP
Bull Gulch	Rangeland	98	98	62	SSTEMP
Beaver Creek	Rangeland	97	97	59	SSTEMP
Upper Dickshooter Creek	Rangeland	100	100	62	SSTEMP
Lower Dickshooter Creek	Rangeland	94	65	67	SSTEMP

a. Bold = 1998 ã303(d) Listed Segments, b. salmonid spawning, c. maximum daily average temperature, d. cold water aquatic life, e.maximum daily temperature

f. .Stream Segment Temperature Model (Bartholow 1999)

Sediment Load Allocations and Targets

For sediment, the entire load allocation is assigned to the current primary land use, rangeland. Tables 41 and 42 show the load allocation calculations in tons/year for the sediment portion of the TMDL. Table 43 shows the turbidity targets to achieve load allocation for the reservoirs. Tables 44 shows the required percent fines targets to achieve load allocation. Table 45 shows the required streambank erosion rate targets to achieve the load allocation.

Table 41. Sediment Load Allocation for a target of 50 mg/l. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity tons/year	MOS[a] tons/year	Load Allocation tons/year
Deep Creek	Rangeland	2,555	255.5	2299.5
Castle Creek	Rangeland	579	57.9	521.1
Nickel Creek	Rangeland	19	1.9	17.1
Upper Blue Creek Basin	Rangeland	331	33.1	297.9
Upper Juniper Basin	Rangeland	96	9.6	86.4

a. Margin of Safety

Table 42. Sediment Load Allocation for a target of 80 mg/l. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity tons/year	MOS[a] tons/year	Load Allocation tons/year
Deep Creek	Rangeland	4088	408.8	3679.2
Castle Creek	Rangeland	927	92.7	834.3
Nickel Creek	Rangeland	31	3.1	27.9
Upper Blue Creek Basin	Rangeland	530	53.0	477.0
Upper Juniper Basin	Rangeland	154	15.4	138.6

a. Margin of Safety

Table 43. Turbidity Load Allocations at 25 NTUs. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity (NTUs)[a]	MOS[b] (NTUs)	Load Allocation (NTUs)
Blue Creek Reservoir	Rangeland	25	2.5	22.5
Juniper Basin Reservoir	Rangeland	25	2.5	22.5

a. Nephelometric Turbidity Unit, b. Margin of Safety

Table 44. Percent Fine Allocations. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity 30%[a]	MOS[b] at 30% Load Capacity	Load Allocation
Deep Creek	Rangeland	30%	3%	27%
Nickel Creek	Rangeland	30%	3%	27%
Castle Creek	Rangeland	30%	3%	27%

a. >6 mm b. Margin of Safety

Table 45. Streambank Erosion Rates. Upper Owyhee Watershed.

Stream	Land Use	Load Capacity tons/mile/year	MOS[b] tons/mile/year	Load Allocation tons/mile/year
Deep Creek	Rangeland	9.7	1.0	8.7
Castle Creek	Rangeland	48.3	4.8	43.5
Nickel Creek	Rangeland	10.6	1.0	9.6
Upper Blue Creek Basin	Rangeland	8.8	0.9	7.9
Upper Juniper Basin	Rangeland	3.8	0.4	3.4

a. Margin of Safety

5.5 Conclusion

The above tables describe the required load allocation to address both temperature and sediment issues in the Upper Owyhee Watershed. All allocations are gross estimates with the belief that once more data is collected by the appropriate land management agencies, and other interested parties, refinements to these allocations can be made.

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GIS Coverages:

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